ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Mathematics & Statistics B

Unit MBM3

Key to mark scheme

M	mark is for	method
m	mark is dependent on one or more M marks and is for	method
A	mark is dependent on M or m mark and is for	accuracy
B	mark is independent of M or m marks and is for	method and accuracy
E	mark is for	explanation
√ or ft or F		follow through from previous incorrect result
CAO		correct answer only
AWFW		anything which falls within
AWRT		anything which rounds to
AG		answer given
SC		special case
OE		or equivalent
A2,1		2 or 1 (or 0) accuracy marks
– *x* EE		Deduct *x* marks for each error
NMS		No method shown
PI		Perhaps implied
c		Candidate

Abbreviations used in marking

MC – *x*	deducted *x* marks for miscopy
MR – *x*	deducted *x* marks for misread
ISW	ignored subsequent working
BOD	gave benefit of doubt
WR	work replaced by candidate

Application of mark scheme

Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Question Number and Part	Solution	Marks	Total	Comments
1(a)(i)	$s_1 = \frac{1}{2}\times 0.2\times 8^2 = 6.4\,\text{m}$	M1 A1	 2	Constant acceleration equation with $u = 0$ Correct distance
(ii)	$v = 0.2\times 8 = 1.6\,\text{ms}^{-1}$	M1 A1	 2	Constant acceleration equation with $u = 0$ Correct velocity
(iii)	$s_2 = 1.6\times 3 = 4.8\,\text{m}$ $s = 6.4 + 4.8 + 1 = 12.2\,\text{m}$	M1 A1	 2	Finding stage II distance Correct total distance
(b)	$1 = \frac{1}{2}(0+1.6)t_3$	M1		Equation to find stage III time
	$t_3 = 1.25$	A1		Correct time
	$t = 8 + 3 + 1.25 = 12.25\,\text{s}$	A1	3	Correct total time
(c)	$T - 600\times 9.8 = 600\times 0.2$	M1		Three term equation of motion
		A1		Correct equation
	$T = 6000\,\text{N}$	A1	3	Correct tension
	Total		**12**	
2(a)	$R + 100\sin 20° + 60\sin 50° = 490$	M1		Resolving vertically
		A1		Correct equation
	$R = 410$	A1	3	Correct R
(b)(i)	$100\cos 20° - 60\cos 50° - F = 25$	M1		Four term equation of motion
		A1		Correct equation
	$F = 30.4$	M1		Solving for F
		A1	4	Correct F from correct working
(ii)	$30.40 = \mu\times 409.8$	M1		Use of $F = \mu R$
	$\mu = 0.0742$	A1	2	Correct μ
	Total		**9**	
3(a)(i)	Initial KE $= \frac{1}{2}\times 65\times 2^2$	M1		Use of KE formula
	$= 130\,\text{J}$	A1	2	Correct energy
(ii)	$65\times 9.8h = 130$	M1		Using $mgh = 130$
	$h = \frac{130}{637} = 0.204\,\text{m (to 3 sf)}$	A1	2	Correct h
(b)(i)	$\text{KE} = 130 + 65\times 9.8\times 6 = 3950\,\text{J}$ (3 sf)	M1		Sum of KE+PE or PE at $h = 6.204$
		A1		Correct equation
		A1	3	Correct energy
(ii)	$\frac{1}{2}\times 65v^2 = 3952$	M1		Use of KE formula to find v
	$v = \sqrt{121.6} = 11.0\,\text{ms}^{-1}$	A1	2	Correct v from their energy in part 3 (b)(ii)
	Total		**9**	

Question Number and Part	Solution	Marks	Total	Comments
4(a)	$v = \int 20\sin 4t\,\mathrm{d}t$	M1		Attempt to integrate a
	$= -5\cos 4t + c$	A1		Correct integral with or without c
	$t = 0, v = 0 \Rightarrow c = 5$	M1		Finding c
	$v = 5 - 5\cos 4t$	A1	4	Correct c
(b)	$s = \int 5 - 5\cos 4t dt$			
	$= 5t - \frac{5}{4}\sin 4t + c$	M1		Attempt to integrate v
		A1		Correct integral with or without c
	$t = 0, s = 0.8 \Rightarrow c = 0.8$	M1		Finding c
	$s = 5t - \frac{5}{4}\sin 4t + 0.8$	A1	4	Correct c
	Total		**8**	
5(a)	$40\mathbf{i} - 15\mathbf{j} = \frac{1}{2}(5\mathbf{i} - 2\mathbf{j} + \mathbf{v}) \times 10$	M1		Use of constant acceleration equation with **v** unknown
		A1		Correct equation
	$\mathbf{v} = 8\mathbf{i} - 3\mathbf{j} - 5\mathbf{i} + 2\mathbf{j} = 3\mathbf{i} - \mathbf{j}$	M1		Solving for **v**
		A1	4	Correct **v**
(b)	$3\mathbf{i} - \mathbf{j} = 5\mathbf{i} - 2\mathbf{j} + 10\mathbf{a}$	M1		Use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t$
		A1		Correct equation
	$\mathbf{a} = -0.2\mathbf{i} + 0.1\mathbf{j}$	A1	3	Correct **a**
(c)	$\mathbf{F} = 15(-0.2\mathbf{i} + 0.1\mathbf{j})$	M1		Use of $\mathbf{F} = m\mathbf{a}$
	$= -3\mathbf{i} + 1.5\mathbf{j}$	A1		Correct **F**
	$F = \sqrt{3^2 + 1.5^2} = 3.35$	M1		Finding magnitude of **F**
		A1	4	Correct magnitude
	Total		**11**	
6(a)(i)	$R\cos 60° = 3 \times 9.8$	M1		Resolving vertically
		A1		Correct equation
	$R = 58.8$ N	A1	3	Correct R
(ii)	$58.8\cos 30° = 3 \times \frac{v^2}{0.5}$	M1		Resolving vertically
		A1		Correct equation
		M1		Solving for v
	$v = \sqrt{\frac{58.8\cos 30°}{6}} = 2.91\,\mathrm{ms}^{-1}$	A1	4	Correct v
(b)(i)	No change	B1	1	No change
(ii)	Increased because v^2 is proportional to the radius	B1		Increases
		B1	2	Reason
	Total		**10**	

Question Number and Part	Solution	Marks	Total	Comments
7(a)	$20\times9.8=\frac{0.7\lambda}{2}$	M1		Use of $T = mg$
		A1		Correct equation
	$\lambda=\frac{2\times20\times9.8}{0.7}=560$	A1	3	Correct result from correct working
(b)(i)	$20\times9.8L=\frac{560(L-2)^2}{2\times2}$	M1		Two term energy equation
		A1		Correct terms
		A1		Correct signs
	$196L=140L^2-560L+560$	m1		Expanding and simplifying
	$5L^2-27L+20=0$	A1	5	Correct result from correct working
(ii)	$L=\frac{27\pm\sqrt{27^2-4\times5\times20}}{2\times5}$	M1		Solving a quadratic
	$=4.51$ or 0.886	A1		Correct solutions
	$L=4.51$	A1	3	Selecting the appropriate solution
	Total		**11**	
8(a)(i)	$s(10)=25-100+150=75$	B1	1	Correct distance
(ii)	$v=\frac{t^3}{100}-\frac{3t^2}{10}+3t$	M1		Differentiating s
		A1		Correct derivative
	$v(10)=10-30+30=10$	A1	3	Correct v
(iii)	$a=\frac{3t^2}{100}-\frac{3t}{5}+3$	M1		Differentiating v
		A1		Correct derivative
	$a(10)=3-6+3=0$	A1	3	Correct a
(b)	$h=10$	B1		Value of h
	$75=100-k$	M1		Substituting $s=75$ and $t=10$
	$k=25$	A1	3	Correct k
	Total		**10**	
	TOTAL		**80**	